

# The Relationship among Tourism Development, Economic Growth and Environmental Pollution

## -- Empirical Test based on Provincial Panel Data

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### Abstract

By selecting panel data from 28 provinces in China from 2006 to 2015, a panel fixed-effect model of tourism revenue, economic growth and environmental pollution is established. The empirical results show that the relationship between economic growth and environmental pollution is positive in the short term and inverted "U" in the long term; the development of tourism can not only promote economic growth, but also improve the environment significantly. And there is a virtuous circle between them. Therefore, all regions in China should develop tourism industry according to local conditions and give full play to the dual role of tourism.

### Keywords

Tourism income; economic growth; environmental pollution; panel fixed effect model.

### 1. Introduction

In the 21st century, tourism industry has undoubtedly become an important driving force for national and regional economic growth, both globally and in China. [1] Statistics indicate that China's domestic tourism exceeded 4 billion person-times, tourism revenue exceeded 4 trillion yuan, and outbound tourism was 120 million person-times in 2015. China ranks first in the world in terms of domestic tourism, outbound tourism, domestic tourism consumption and overseas tourism consumption. According to the data calculated by the National Tourism Data Center show that my country's tourism employment accounted for 10.2% of the total employment. (Data source: Ministry of Culture and Tourism of the People's Republic of China.) For a long time, China has been an extensive economic growth model of the 'three highs', relying too much on the promotion of the industrial economy, causing serious damage to the ecological environment. Now China's economy has entered a new normal, and the adjustment of industrial structure is the main way of China's economic growth. The prosperity and development of tourism have chain effect, which can not only provide new impetus for regional economic growth, but also improve the ecological environment and form a virtuous circle of regional development.

In the past research, remarkable achievements have been made in the research of the relationship among tourism development, economic growth and environmental pollution. However, the research methods are mostly qualitative research, and quantitative research methods are relatively rare. Based on the panel data of 28 provinces in China, this paper tests the relationship among tourism development, economic growth and environmental pollution by using panel fixed effect model.

## 2. Model Establishment and Data Description

### 2.1. Model Establishment

The analysis of the relationship among tourism income, economic growth and environmental pollution can provide an important theoretical basis for the adjustment of industrial structure and the protection of ecological environment in our country. This paper draws on the research of Guo Jiaming [2] and Shi Yujun [3] to establish the econometric model of tourism income, economic growth and environmental pollution. The model is established as follows:

$$\ln q_{it} = \beta_0 + \beta_1 \ln \text{gdp}_{it} + \beta_2 \ln T_{it} + v_i + \epsilon_{it} \quad (1)$$

Among them,  $t$  represents the area,  $i$  represents the current time,  $q$  is the predicted variable, represents environmental pollution,  $T$  represents control variable, which represents technological progress,  $\beta_0$  is a constant term,  $\beta_1$ ,  $\beta_2$  are the coefficients of each variable,  $v_i$  is the individual effect,  $\epsilon_{it}$  is the random error term, and the formula (1) is the basic model, which represents the linear relationship between economic growth and environmental pollution.

In order to show whether there is a long-term nonlinear relationship between economic growth and environmental pollution, this article introduces the square term of economic growth, [2] the model is as follows:

$$\ln q_{it} = \beta_0 + \beta_1 \ln \text{gdp}_{it} + \beta_2 \ln \text{gdp}_{it}^2 + \beta_3 \ln T_{it} + v_i + \epsilon_{it} \quad (2)$$

Because economic growth and tourism development can have an impact on the environment to a certain extent, in order to do the relationship between tourism development and environmental pollution, the explanatory variable tourism income  $Y$  is introduced to replace economic growth  $GDP$  in this paper, and for a better explanation concerning the relationship between tourism income and environmental pollution, this paper uses the Lagged Item  $Y_{i, t-1}$  of tourism income as the explanatory variable. The model is as follows:

$$\ln q_{it} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln T_{it} + v_i + \epsilon_{it} \quad (3)$$

$$\ln q_{it} = \beta_0 + \beta_1 \ln Y_{i, t-1} + \beta_2 \ln T_{it} + v_i + \epsilon_{it} \quad (4)$$

In order to investigate the long-term nonlinear relationship between tourism income and environmental pollution, the model further introduces the square term of the lag item of tourism income. The model is as follows:

$$\ln q_{it} = \beta_0 + \beta_1 \ln Y_{i, t-1} + \beta_2 \ln Y_{i, t-1}^2 + \beta_3 \ln T_{it} + v_i + \epsilon_{it} \quad (5)$$

### 2.2. Data Description

(1) Environmental pollution ( $q$ ). The overall measurement index of environmental pollution is still controversial. In the existing research, most of the individual indicators are used to measure environmental pollution. Considering the current emission of  $SO_2$  and  $SO_2$  as the main component of air pollution in China, this article selects the total emission of  $SO_2$  as the measurement index of environmental pollution.

(2) Economic growth ( $GDP$ ). In the initial stage of economic growth, due to the relatively low productivity, economic growth is mostly at the expense of the ecological environment, and as the level of economic development improves, environmental pollution will be more serious, but with the improvement of people's material living standards, higher requirements are put

forward for the living environment, which urges the government to formulate corresponding environmental protection policies to improve the ecological environment. This article uses the GDP of China's 28 provincial-level administrative units to represent economic growth, however for the sake of data stability, it is replaced by annual GDP growth rate.

(3) Tourism income (Y). The development of tourism can change the local industrial structure to a certain extent and reduce pollution caused by industrial development. Tourism income can most intuitively reflect the development of regional tourism. The tourism income in this article refers to the total tourism income, including domestic tourism income and international tourism income.

(4) Control variable (T). Scientific and technological progress can reduce the emission of environmental pollutants and improve the treatment capacity of environmental pollution through technical means. In this paper, the transaction volume of technology market is selected as the proxy variable to represent the level of scientific and technological progress in various regions.

### 2.3. Data Sources

Based on the availability of data, this paper selects panel data of 28 provincial-level administrative units in China (the data is missing in Tibet, Tianjin, and Chongqing) from 2006 to 2015, and the data are from China Statistical Yearbook and Statistical Yearbook of provinces, autonomous regions and municipalities directly under the central government. In order to eliminate the heteroscedasticity and statistical bias, the related variables were processed by natural logarithm. The descriptive statistics of the variables are shown in Table 1 below:

**Table 1.** Descriptive statistics of variables

Variable	Symbol	Observed	Value Mean	Maximum Value	Minimum Value	Variance
Total pollution emissions	lnq	280	13.27	14.49	10	0.77
Economic growth	lngdp	280	-2.08	-0.44	-5.97	0.55
Tourism income	lnY	280	7.04	9.11	3.25	1.43
Technological progress	lnT	280	3.62	8.15	-0.63	3.19

Note: The relevant results are calculated based on the data of China Statistical Yearbook.

### 3. Empirical Results and Analysis

Based on the above data collation and analysis, this paper makes an empirical analysis on tourism income, economic growth and environmental pollution. Before the panel data regression, the Hausman test was first performed on the variables, and the test results showed that it is more effective to use the fixed-effect model. Therefore, this article chooses the fixed-effect model for regression analysis. As for the endogenous problems of the model, the lagged term of the variable is used to deal with it. In Table 2, the results of formula (3) and formula (4) show that the regression results of tourism income in the current and subsequent period are both significant, and the difference is very small, so there is no serious endogenous problem in the model.

According to Table 2, in equation (1), the coefficient of the explanatory variable lngdp is 0.04, which has passed the significance test at the level of 1%, indicating that for every 1 percentage

point increase in the economy, the total amount of pollution emissions will increase by 0.04 percentage points. That is, as the economy grows, the environment will deteriorate further; Equation (2) introduces the square term of economic growth to determine whether there is a long-term nonlinear relationship between economic growth and environmental pollution, and the regression results show that the coefficient of the square term of economic growth is -0.01, which has passed the significance test at the level of 10%, and the first-order coefficient of economic growth is 0.04, which has passed the significance test at the 1% level, It shows that the relationship between economic growth and environmental pollution conforms to the Kuznets inverted U-shaped curve characteristics, that is, with economic growth, the environment will further deteriorate, but with further economic growth, the environment will be improved; in equation (3), the regression coefficient of tourism income is -0.06, which has passed the significance test at the level of 5%, that is, for every 5 percentage points increase in tourism income, the total amount of pollution emissions will decrease by 0.06 percentage points; in order to overcome endogeneity, the lagged item of tourism income is introduced in equation (4), the regression results are realistic, the coefficient is -0.07, and the significance test is passed at the level of 1%, indicating that with the increase of tourism income, pollution emissions will be further reduced and the environment will be better improved; in order to examine the long-term nonlinear relationship between tourism income and environmental pollution, equation (5) introduces the lagged item of the square term of tourism income, the regression result shows that the coefficient is -0.02, which has passed the significance test at the level of 1%, indicating the long-term effect of tourism income on the environment improvement is still significant.

**Table 2.** Regression results of fixed effect model

Variable	Total Pollution Discharge				
	Formula (1)	Formula (2)	Formula (3)	Formula (4)	Formula (5)
lngdp	0.04 (0.01)***	0.04(0.01)***			
lngdp <sup>2</sup>		-0.01(0.01)*			
lnY			-0.06(0.01)**		
lnY <sub>i,t-1</sub>				-0.07(0.03)***	0.98(0.03)***
lnY <sup>2</sup> <sub>i,t-1</sub>					-0.02(0.01)***
lnT	-0.85(0.01)***	-0.09(0.01)***	-0.06(0.02)***	-0.04(0.02)*	-0.03(0.02)
c	13.7(0.05)***	13.8(0.11)***	13.9(0.12)***	13.9(0.13)***	14.3(0.14)***
sigma_u	0.91	0.91	0.93	0.92	0.92
sigma_e	0.15	0.15	0.15	0.14	0.13
rho	0.98	0.98	0.98	0.98	0.98

Note: The numbers in parentheses are the standard errors of robustness, and \*, \*\*, and \*\*\* indicate the significance levels of 10%, 5%, and 1% respectively.

#### 4. Conclusion and Suggestions

In the long-term development of our country, most of them have achieved economic growth at the expense of the environment, and the contradiction between economic growth and environmental pollution has become increasingly prominent. The empirical results of this paper also show that under the control of the inherent level of science and technology, the actual situation of China's economic growth is still the development logic at the cost of the environment. However, according to the Kuznets curve, in the long run, the ecological

environment improvement still requires a high level of economic development. Therefore, the problem of economic growth and environmental pollution is a trade-off between long-term and short-term.

Tourism, as a smoke-free industry, can adjust the industrial structure and stimulate local economic growth while reducing the environmental pollution caused by industrial development. Vigorously developing tourism can also promote the transformation and development of the urban economy; [4] In fact, the improvement of the ecological environment can also promote the development of tourism, thus forming a virtuous circle and then forming a long-term mechanism for economic growth.

China is rich in tourism resources, but the development status of the tourism industry and economic structure in various regions are quite different. Therefore, we should actively explore the development of the tourism industry according to local conditions, rationally develop and utilize tourism resources, and realize the coordinated development of 'industry + tourism', so as to achieve the optimization and improvement of the ecological environment. Specifically, the following measures can be taken:

First, further explore the potential tourism resources. Combining local customs, historical culture, geographical climate and other characteristics, we should strengthen the development of special tourism and eco-tourism projects, and continuously increase the added value of the tourism industry, [5] so as to realize a virtuous circular mode in which tourism promotes economic growth and economic growth can feed back the development of tourism industry. [6] Second, further promote the optimization and upgrading of the industrial structure. Relying on the adjustment mechanism of market to alleviate the distortion and mismatch of factor resources and achieve the balanced distribution of resource elements among departments, thereby improving the organizational efficiency of tourism products, enhancing the proportion of tourism industry, and realizing the advanced adjustment of industrial structure. [7]

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